F764Un

cop2

Research Note

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
INTERMOUNTAIN FOREST & RANGE EXPERIMENT STATION
OGDEN UTAH

USDA Forest Service
Research Note INT-113 1970

FERTILIZING TO IMPROVE ELK WINTER RANGE IN MONTANA

Joseph V. Basile[1]

ABSTRACT

Six fertilizer treatments were applied to a low-producing site and to a high-producing site to determine fertilizer benefits. The forage yields of both were checked for two growing seasons following application. Of the fertilizers tested, the 200-0-0 fertilizer seems most appropriate for the low-producing site. This treatment resulted in a 2½-fold gain in forage yields the first and second years, and produced a significant change in the grass-forb ratio. The high-producing site responded to fertilizers with a 50-percent gain in yield the first year, but treatment responses did not differ significantly from the response on the controls the second year. Grass-forb ratios were unchanged on the high-producing site. Fertilizing may be a valuable restorative measure on low-producing range sites, when it complements a sound herd management program.

The winter range of the Upper Gallatin elk herd in southwestern Montana straddles lands administered by the USDA Forest Service, the National Park Service, and the Montana Fish and Game Department. Historical evidence and range surveys show that range condition has been trending downward since the end of the last century.[2] This downward trend prompted the Forest Service to curtail livestock grazing on part of the area as early as 1908, to halt such grazing on the entire elk winter range east of the Gallatin River in 1919 and on the range west of the river in 1932. Despite the livestock ban, it was apparent by the mid-1920's that range condition was still deteriorating.

In 1965, the three agencies adopted a coordinated management program to balance the elk herd and its winter forage supply. To accomplish this they set a tentative wintering population figure (1,000 elk). This program may improve forage conditions on part of the winter range. However, a deteriorated condition is common on ridgetops and south-facing slopes, where several exclosures (20-plus years of age) show little recovery to date from protection alone. Though low in productivity, many of these sites still support residual vegetation of sufficient density and tenacity to suggest

---

[1]Range Scientist, stationed in Bozeman, Montana, at the Forestry Sciences Laboratory, maintained in cooperation with Montana State University.

[2]Allen Lovaas. Gallatin big game studies. Montana Fish and Game Dep. Job Completion Rep., Proj. W-98-R-4, 5 p. 1965.

that fertilizing may be a restorative measure, provided it is coordinated with a herd management program. For example, 12 years after receiving a single application of nitrogen (rate unknown), an unfenced plot on this winter range produced 2½ times more dry matter than the surrounding untreated area. The increases in plant vigor, crown area, and litter that usually accompany production gains of this magnitude help to stabilize soil and to improve range condition.

This interim report on continuing research describes the initial responses of study sites to fertilizers and the second-year residual effects of fertilizers on forage production. The interest, services, and cooperation of the Montana Fish and Game Department and of Glennis O. Boatwright, Agricultural Research Service, are gratefully acknowledged.

THE STUDY AREA

The winter range is a complex of intermontane valleys that range in elevation from 6,000 to 8,000 feet. Mean annual precipitation is estimated at 15 to 18 inches.

The study sites are at an elevation of about 6,400 feet. Vegetation is predominantly a grass-forb mixture and a scattering of shrubs, mainly fringed sagebrush (*Artemisia frigida*), rabbitbrush (*Chrysothamnus viscidiflorus*), and gray horsebrush (*Tetradymia canescens*). Dominant grasses are: bluebunch wheatgrass (*Agropyron spicatum*); thickspike wheatgrass (*A. dasystachyum*); Idaho fescue (*Festuca idahoensis*); bluegrass (*Poa* spp.); and prairie junegrass (*Koeleria cristata*). Common forbs include: yarrow (*Achillea millefolium*); pussytoes (*Antennaria* spp.); ballhead sandwort (*Arenaria congesta*); fernleaf fleabane (*Erigeron compositus*); sulfur eriogonum (*Eriogonum umbellatum*); and lupines (*Lupinus* spp.)

METHODS

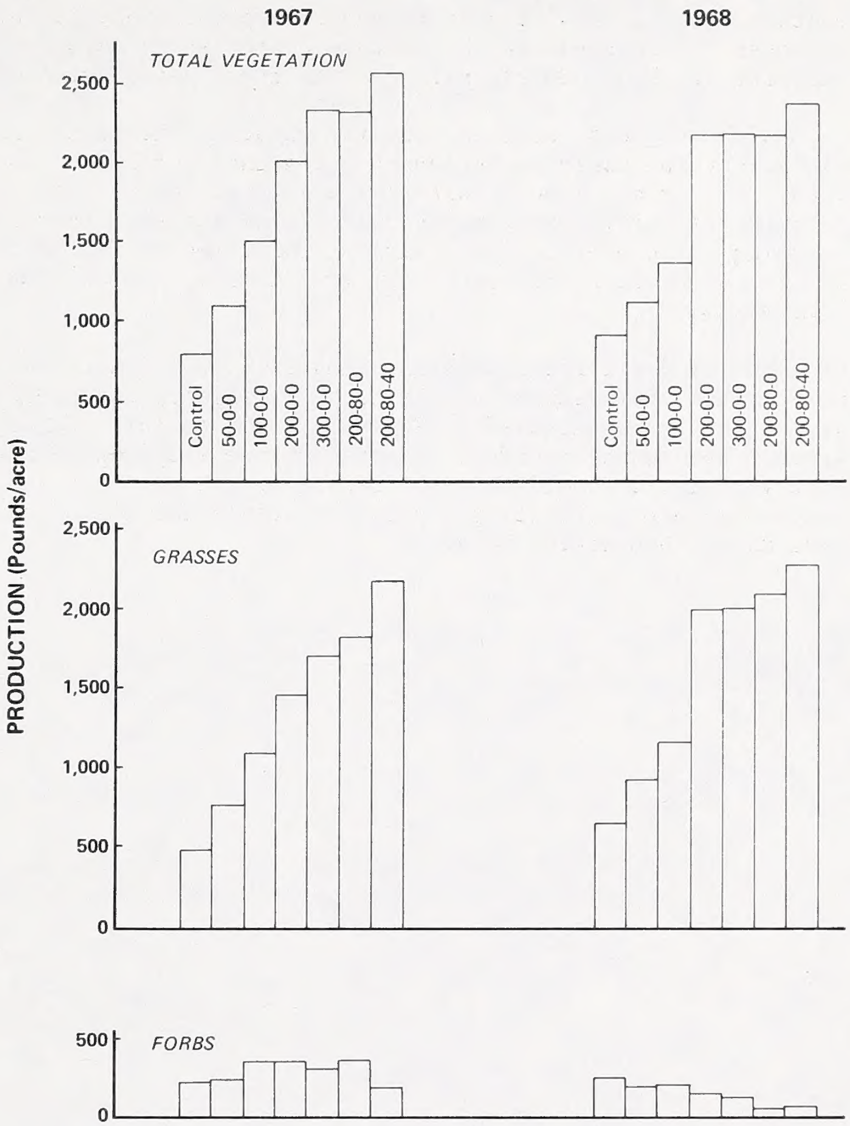
In September 1966, seven treatments in three replicates were applied to 21 contiguous strips in each of two locations--one a low-producing, heavily-grazed ridgetop, the other a high-producing, lightly-to-moderately grazed benchland. Each ridgetop strip was 6 by 20 feet, each benchland strip, 10 by 40 feet. Ammonium nitrate (33-0-0), treble superphosphate (0-45-0), and potassium chloride (0-0-63) were broadcast at the following rates:

N	P	K
(Lbs./acre)		
0	0	0
50	0	0
100	0	0
200	0	0
300	0	0
200	80	0
200	80	40

The two sites then were fenced to exclude elk.

In early August of 1967 and 1968, all current-year vegetation was clipped at ground level from 1- by 4.8-foot plots, kept at 60°C. for 24 hours, and dried weight determined. Each year, four plots per strip were clipped on the ridgetop site, and five plots per strip were clipped on the benchland site. Random location of plots differed the second year to avoid the influence of previous clipping. Moreover, buffer zones along the sides of each strip precluded the possibility of sampling from areas of overlapping fertilizer effects.

Figure 1.--First- and second-year responses to fertilization of a low-producing site on elk winter range in Montana.



RESULTS

Because of their low density and small contribution to overall production, shrubs are not considered separately in the following discussion. However, shrub yields are included in the values for total vegetal production.

Ridgetop Site

On the poorer site, initial (1967) and residual (1968) responses were of essentially the same pattern and magnitude (fig. 1), an indication that the effects of

fertilizer treatments carried over through the second growing season. Sequential tests of differences between means showed the following:

N-P-K	Responses 1967	Responses 1968
0-0-0		
50-0-0		
100-0-0		
200-0-0		
300-0-0		
200-80-0		
200-80-40		

where lines connect treatments whose means did not differ significantly from each other.

The 200-0-0 fertilizer seems most appropriate for the ridgetop site. This rate of nitrogen application produced an initial response that was significantly greater than, or equal to, those produced by other rates of nitrogen application. Furthermore, the response was not statistically different from that resulting from the 200-pound rate with phosphorus added. The initial response to the 200-0-0 fertilizer was exceeded by that of the 200-80-40 fertilizer, but residual responses to these two fertilizers did not differ significantly.

In addition to the impressive initial production that resulted from the 200-0-0 treatment, the site's best second-year production response was to the same fertilizer. When compared to total forage yields on control strips, 1968 production attributed to the 200-0-0 fertilizer stayed close to the 2½-fold increase obtained in 1967. Production response to all other fertilizers tested showed a considerably larger drop between years. Aside from a few exceptions, this was true for grasses and forbs as well as for total vegetation.

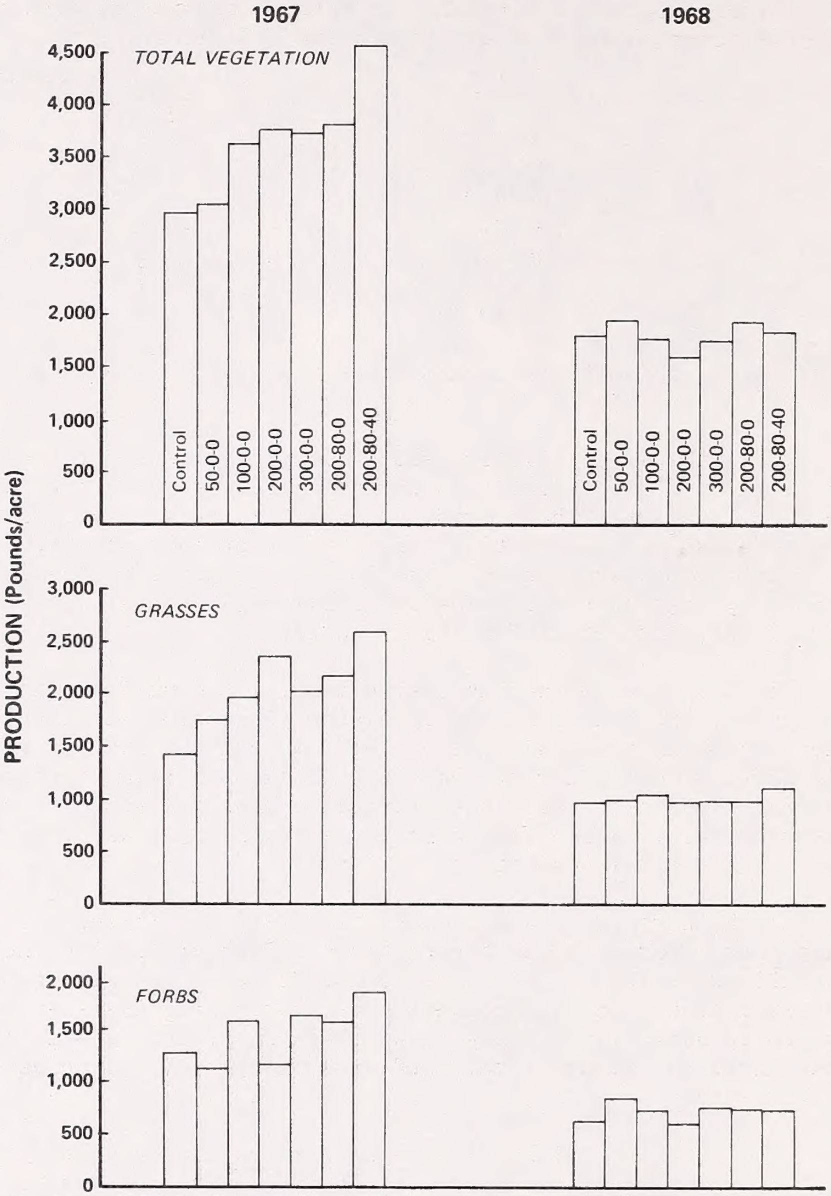
In both years, grass production on all fertilized strips was markedly greater than grass production on the controls. Forb production increased moderately on most fertilized strips the first year, but decreased on all strips the second. These opposite trends in the production responses of grasses and forbs to fertilizers resulted in appreciable changes in grass-forb ratios (table 1)--particularly apparent when nitrogen, alone or combined with phosphorus and potassium, was applied at the higher rates.

Table 1.--Grass-forb ratios on fertilized strips the first and second years after treatment

	Treatment						
	Control	50-0-0	100-0-0	200-0-0	300-0-0	200-80-0	200-80-40
	Ratio[1]						
Ridgetop site							
1967	2.2	3.3	3.3	4.3	5.5	5.1	11.8
1968	2.6	4.8	5.7	12.9	16.3	38.9	36.2
Benchland site							
1967	1.1	1.5	1.2	2.0	1.2	1.4	1.4
1968	1.5	1.2	1.4	1.6	1.3	1.3	1.5

[1]Grass production as a multiple of forb production.

Figure 2.--First- and second-year responses to fertilization of a high-producing site on elk winter range in Montana.



Benchland Site

Initial results on this high-producing site suggest two populations of response, one of which includes the control and 50-0-0 nitrogen treatment, the second, all other treatments. Fertilizer effects were short lived, however; no significant differences were detected between treatment responses and responses on controls the second year (fig. 2).

When compared with production on the controls, modest first-year increases in grass production were erased the second year, and forb production was essentially the same both years. Consequently, grass-forb ratios (table 1) were virtually unchanged.

CONCLUSIONS

Murie[3] reported that elk eat approximately 10 pounds of forage per day (average for bulls, cows, and 8- to 9-month-old calves). On the ridgetop site, total production on the strips treated with 200-0-0 exceeded that on the controls by 1,221 pounds per acre in 1967 and by 1,262 pounds per acre in 1968. Thus, carrying capacity for a 5-month season appears to have increased approximately 0.8 elk per acre. The best response to treatment on the benchland site shows an apparent increase in carrying capacity of about one elk per acre the first year, but none at all, the second.

Such *apparent* gains in carrying capacity should not be construed to mean that the elk population could be increased 0.8 animal (or by any amount) for every acre fertilized. Poor range conditions dictate against any increase in herd size. The gain in carrying capacity merely reflects, to some degree, reduced grazing pressure exerted by existing elk numbers. Quite simply, the value of fertilizing lies in its potential for assisting range recovery *when used in conjunction with a sound program of herd management*.

Use of fertilizers on high-producing, good condition range sites appears to be unwarranted, but results on the harsher ridgetop site were so encouraging that fertilizer trials were extended in September 1968 to three other low-producing, poor condition sites. Should the residual response on the ridgetop remain satisfactory for one or more years, and should the performance on the new test sites approximate that on the ridgetop, then fertilizing may be a valuable complement to the current herd management program on this winter range.

[3]Olaus J. Murie. The elk of North America. 376 p., illus. Harrisburg, Pa. The Stackpole Company. 1951.